SECTION 9

AROUND THE WORLD

Searching to find safe drinking water.

OUTCOME: WHAT STUDENTS WILL LEARN

- Water is essential for life.
- Why there is a global water crisis.
- How communities adapt to create safe drinking water.

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Core Content Standards

Writing

WR-E-1.4 Transactive writing

Science

SC-E-2.1.2 Earth materials provide many of the resources humans use. The varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials, as sources of fuel, or growing the plants we use for food.

SC-E-3.1.2 Organisms have basic needs. For example, animals need air, water, and food; plants need air, water, nutrients, and light. Organisms can surive only in environments in which their needs can be met.

SC-E-3.3.3 All organisms, including humans, cause changes in the environment where they live. Some of these changes are detrimental to the organism or to other organisms; other changes are beneficial.

Social Studies

SS-E-3.1.1 Scarcity requires people to make choices about using goods, services, and limited resources.

SS-M-3.1.1 Productive resources are limited and do not satisfy all the wants of individuals, societies, and governments.

SS-E-4.1.1 Simple physical, political, and thematic maps, globes, charts, photographs, aerial photography and graphs can be used to find and explain locations and display information.

SS-E-4.1.5 Different factors in one location can have an impact on another location.

SS-M-4.1.1 Maps, globes, photographs, models, and satellite images are representations of Earth with different characteristics and uses.

SS-M-4.1.2 Different factors affect where human activities are located and how land is used in urban, rural, and suburban areas.

SS-E-4.2.1 Every place is unique and can be described by its human and physical characteristics.

SS-E-4.2.1 Places can be made distinctive by human activities that alter physical features.

SS-E-4.2.2 Regions are areas that have one or more physical or human characteristics in common.

SS-E-4.3.2 Humans usually settle where there are adequate resources to meet their needs.

SS-M-4.3.2 Human populations may change and or migrate because of factors such as war, famine, disease, economic opportunity, and technology.

Practical Living

PL-E-1.3.2 There are good health and hygiene practices that affect self and others and assist in preventing the spread of diseases.

PL-E-1.3.3 There are strategies to promote good health and prevent childhood illnesses and communicable and noncommunicable diseases.

PL-M-3.3.2 Improving environmental conditions and preserving natural resources impact personal and community health.

Water is Sacred

Most of us take water for granted – we turn on the faucet and it's there. But in many parts of the world that's not the case. Good safe drinking water is sacred.

In the developing world over one billion people don't have access to safe drinking water. And even more people don't have adequate sanitation services.

As a result, 6,000 people, mostly children, die every day.

What's the Problem?

In **developing countries**, people are poor and often don't have a good education. In many cases people don't have the resources or the money to build water and sanitation services.

The problem is two-fold: poor **sanitation** practices and the lack of safe water. Often the people don't understand how sewage can contaminate water. They also don't practice proper **hygiene**, for example hand washing.

Drinking **contaminated** water often leads to water-related diseases like **typhoid** and **cholera**. When there is safe water available, families must walk for miles to get it.

The consequences produce a ripple effect. People are either too sick or don't have time to do productive days of work; hauling water takes hours out of the day, leaving little time for anything else. Children really suffer. School is interrupted when children spend much of their time hauling water or caring for their brothers and sisters while mom hauls the water.

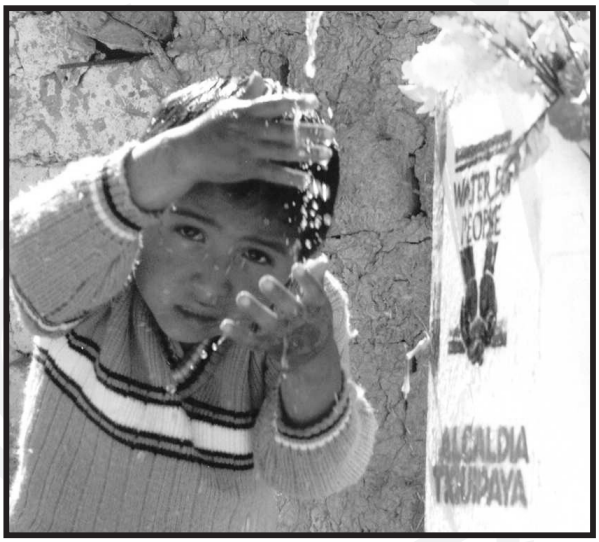
Water = Existence

The United Nations believes the water crisis is at the heart of our population's survival on Earth. The UN estimates that 60 countries and seven billion people will face water shortages by 2050. Seven billion is 75% of the world's projected population of 9.1 billion in 2050. The Ohio River provides an abundant supply of water for our community. World-wide the issue is supply and quality. But science helps people adapt.

Water For People

In 1991, the American Water Works Association founded Water For People, a non profit group that works to help the most impoverished people world-wide improve their quality of life by giving them good drinking water, sanitation and hygiene products.

Water For People adopts countries and provides financial and technical resources to the citizens. Water For People will help villagers dig wells, lay pipe, install sewer systems and then teach them proper hygiene. It's important that the people help create the water and sanitation systems so they have ownership.



Water For People is a non profit group that depends on donations from citizens and corporations. Louisville Water Company is an active supporter.

Visit Water For People's web site at www.waterforpeople.org.

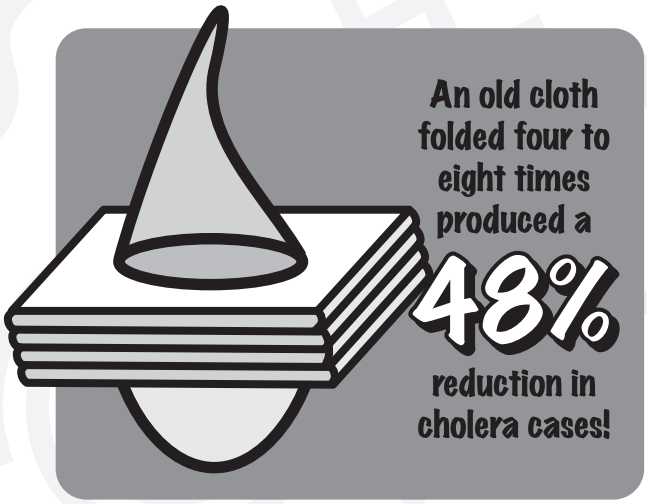
India and Bangladesh

You can look for a source of drinking water on the surface (lakes and rivers) or in the ground. In India and Bangladesh there are problems with both supplies. For surface water, the problem is often cholera, a bacteria that thrives in water. In the ground the problem is arsenic, a toxic element.

A Cloth Filter

Bangladesh is in southern Asia. The country is poor and overpopulated. Monsoons flood the country each year meaning most residents live in areas that will be under water for several months. Because of this, waterborne diseases in surface waters (lakes and rivers) like cholera are widespread. Cholera is created by a bacteria in water. The disease causes severe diarrhea, dehydration and sometimes death. Places that do not use chlorine and filters to treat drinking water are at risk.

Boiling water is the most effective way to purify water when there's no water treatment plant. But fire wood is scarce in Bangladesh. The idea for using a piece of cloth came from watching the people in Bangladesh. A "sari" is the traditional material worn by Indian women. Researchers learned people used an old sari cloth to filter insects out a sugar drink made in the home. Rita Colwell with the University of Maryland took the experiment a step further and tried it with drinking water. Her team found that an old cloth folded four to eight times produced a 48% reduction in cholera cases.



The researchers found that the cholera bacteria "hang" on to planktons (microscopic crustaceans much larger than the bacteria). The planktons and cholera are removed with the sari cloth.

WATER = EXISTENCE

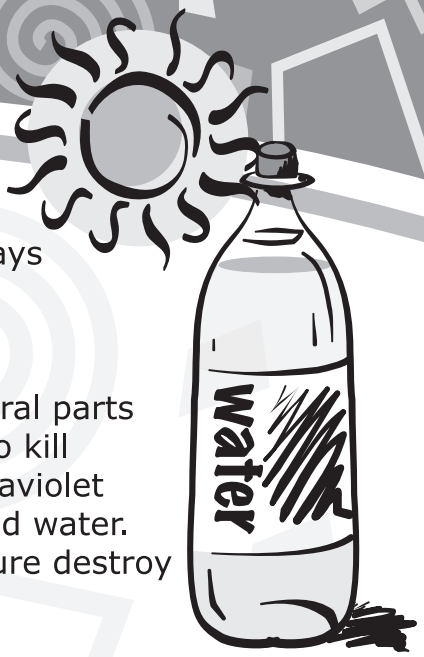
Arsenic and the AMAL Filter

Thousands of people in India dug wells to look for a safer supply of drinking water. However in 1993, researchers found the groundwater, especially in rural areas, contained high levels of arsenic. Arsenic is an element, AS on the periodic table. It's very toxic even in small amounts. Arsenic is part of the Earth's crust and is usually found where copper, gold and zinc are mined. There is arsenic in parts of the western United States. Companies use it to help make electronics and glass products. But arsenic and drinking water do not mix. We do not find arsenic in the Ohio River.

In West Bengal, a state in eastern India, several million people - as many as Kentucky's population – have been exposed to arsenic poisoning. Over time, arsenic can cause serious health problems including cancer and skin lesions.

Villagers work together and share filters. They also pay about 22-cents a month to help cover operating costs.

Water For People, a non-profit group that works to help bring safe drinking water and sanitation to developing countries, partnered with the Bengal Engineering College to create a simple filter villagers could use. Researchers found that activated alumina was most effective in removing the arsenic from water. Better yet the alumina was available locally, it was cost effective and could be used over and over. The AMAL filter (named after the engineer who helped create it) allows the groundwater to pass through 51-inches of activated alumina and eight inches of gravel. The alumina adsorbs arsenic and iron in the water. The water that leaves the filter contains arsenic levels well below Indian drinking water standards.



A Two-liter Bottle and the Sun

You wear sunglasses to help protect your eyes from the harmful rays of the sun. Now scientists use those rays to clean drinking water.

SODIS stands for Solar Water Disinfection Process. Researchers in Switzerland helped develop the process. It's used most often in rural parts of developing countries. SODIS uses a plastic bottle and the sun to kill microorganisms that can live in water and make you sick. The ultraviolet radiation from the sun are invisible but can penetrate your skin and water. For drinking water, the UV rays and the increased water temperature destroy bacteria like e.coli and viruses.

There are water treatment plants in the United States that use ultraviolet rays to clean water, but SODIS can only treat small amounts of water; it's intended for individual households. Many factors make this process work:

- Bottles must be clear, clean and not broken or split.
- Water must be clear, not turbid. That means the water cannot have large amounts of mud or sand.
- Bottles must be filled completely - air bubbles deflect the sunrays.
- The bottles have to be exposed to the sun on something to help conduct heat - like a metal roof, piece of tile or zinc sheet.
- The bottles must be in the sun for at least six hours - especially during the hours of the sun's largest intensity.

Since heat is important, SODIS works in the hot areas of the world like Latin America and Thailand. In Thailand, many villages store rainwater in large containers for drinking. The water is clean but people often get sick because of problems with handling and transporting the water. Two villages began using SODIS before they drank they rain water. Doctors reported a 86% decrease in the number of people looking for help with diarrhea and other stomach problems.

Educate or It's Not Safe

In all of these projects, education is just as important as the science. In Thailand villagers had to learn the importance of cleaning the plastic bottles, where to place the bottles and how to clean the caps.

In West Bengal, villagers watched a play to learn about the problems of arsenic poisoning and how the activated alumina filter could help. In Bangladesh, the villagers learned that the old sari cloth they used had to be rinsed and dried in the sunlight after each use.

In all the examples, people had to learn basic hygiene like when and how to wash hands, bathroom habits, and how easy it is to spread germs from one person to another.

WATER WORDS

Developing country: a country where poverty, education and health problems exist.

Hygiene: practicing good sanitation or good health standards.

Cholera: a disease caused by a microorganism that can sometimes be in contaminated water.

Contaminated: something that is not pure; unsafe.

Sanitation: means of dealing with sewage or waste.

Typhoid: a serious disease that often enters the body through contaminated food or drink.

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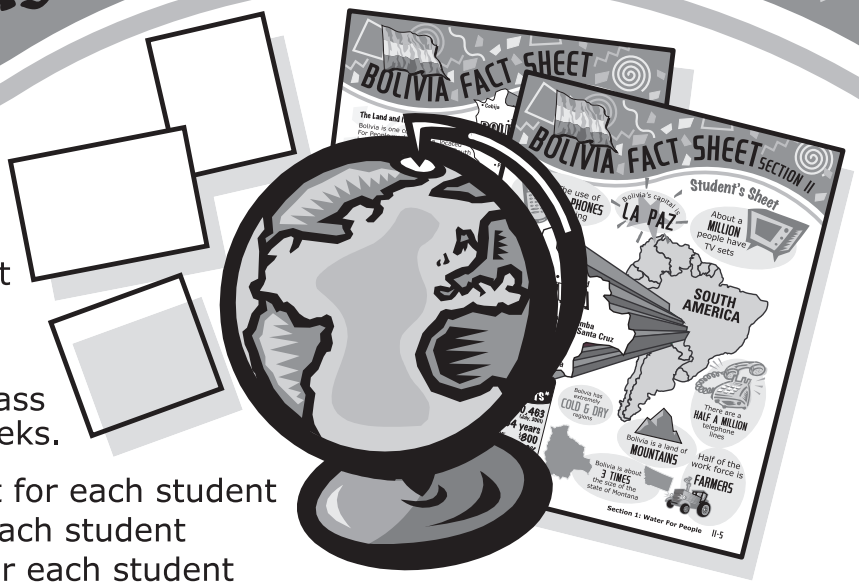
Activity #1: Finding Safe Water in Bolivia



Objective: Students will learn about the country, the problems that exist for safe drinking water and the efforts to remedy the situation.

Time: This exercise can be done in one class period or extended over several weeks.

You'll need: • Globe • Bolivia worksheet for each student
- Copies of "Bolivia Fact Sheet" for each student
- Copies of "Bolivia Water Project" for each student
- Bolivia photographs (link to LWC web site www.tappersfunzone.com and click on "Water for People" or request photographs from LWC)

Teacher note: Water For People works with communities throughout Central and South America, Asia and Africa. While this activity centers on Bolivia, you can learn more about the other countries Water For People works with at wwwwaterforpeople.org and www.tappersfunzone.com.

Here's what to do...

1. Using a globe, have students first locate South America. Then locate Bolivia.
2. What countries surround Bolivia? (Peru, Brazil, Chile, Argentina & Paraguay)
3. Ask students what they notice about Bolivia. (*Comments might include its shape, Spanish names of towns. Ask them about the country's borders. Students should notice that Bolivia is land-locked.)*
4. Go over the Bolivia facts with students (Handout, "Bolivia Fact Sheet" is a good accompaniment.)
5. Give each student a copy of "Bolivia Water Project." Either alone or in groups of four, have students study the problem and then brainstorm how to fix it. Then describe the solution Water For People provided.
6. Show students the pictures and stories of people from Bolivia who received help from water and sanitation projects.

*This is designed for an in-class project. You could also do the above as a research project. Have students learn about the country, its people, the problems they face and possible solutions.

*Louisville Water Company has an accompanying video on the work in developing countries. Contact Kelley Dearing Smith at 569-3600 x2436 or email ksmith@lwcky.com to get a copy on loan. Kelley can also put you in touch with a Water For People project coordinator. Students can benefit from hearing from someone who has visited the country.

*If you're interested in extending this project, many schools across the U.S. have adopted a country and raised money for a water project. Louisville Water Company can also help you with this.

BOLIVIA FACT SHEET

The Land and its People

Bolivia is one country where Water For People works. Bolivia, located halfway down the continent of South America, is a land of mountains, high plateaus and great natural wealth in the form of mineral deposits and natural gas. The resources are hard to get and even harder to get to world markets. Since Bolivia is landlocked it doesn't have a seacoast for shipping. The weather can be tropical in the valleys, but very cold high in the mountains.

Bolivia's capital is La Paz. The country is about three times the size of the state of Montana.

Bolivia is one of the poorest and least developed countries in Latin America. More than half of the people are Indians. There are three primary languages: Spanish, Quechua and Aymara.

Half of the work force in Bolivia makes their living by farming. It's difficult since much of the farming area lies in extremely high, cold and dry regions of the country.

Bolivia Facts*

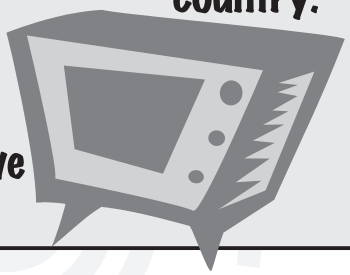
Population:	8,300,463 (July, 2001)
Life expectancy:	64 years
Per capita income:	$800
Access to safe water:	63%
Access to sanitation:	58%

* Source: 1997 WHO statistics

Bolivia's "Luxuries"

Although the use of cell phones is rising, there are only about half a million telephone lines in the country.

About a million people have a TV set.



Community Needs

Bolivia's population is rapidly growing. The country has the highest infant mortality rate in Latin America – about 170 children die out of every 1,000 born. Lack of health services, unsafe drinking water and poor sanitation practices cause outbreaks of infectious diseases.

In the rural villages, women walk miles every day to the nearest water supply – and many times they carry back water that is unsafe to drink.

Water For People's Work

Water For People began working in Bolivia in 1992. The group helps 10-15 communities each year. The typical projects cost between $1,000 and $8,000.

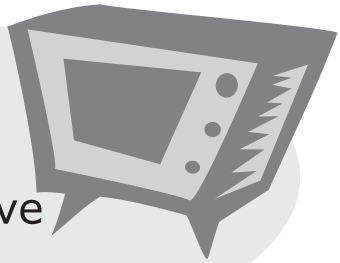
BOLIVIA FACT SHEET

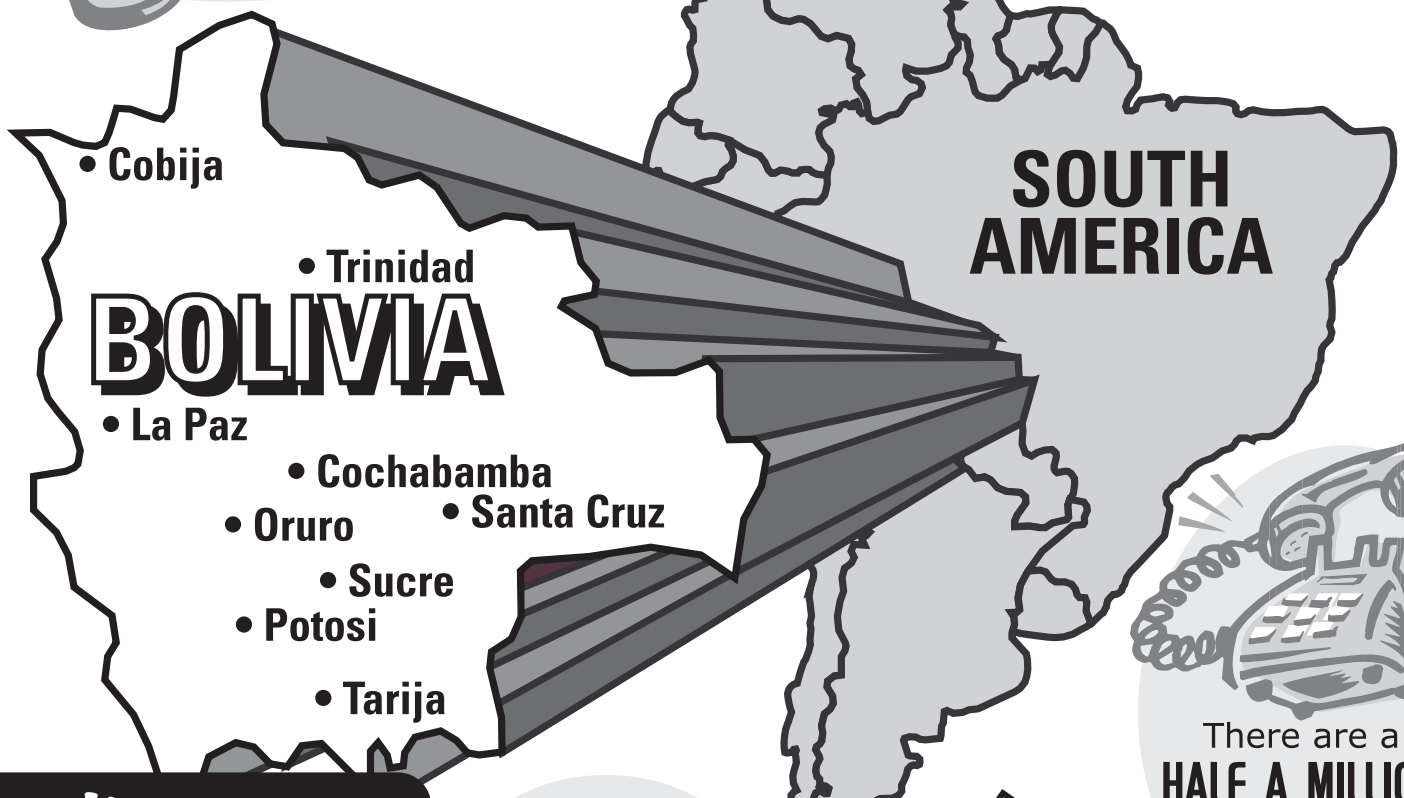
Student's Sheet

The use of **CELL PHONES** is rising

Bolivia's capital is **LA PAZ**

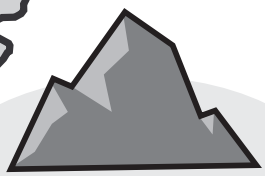
About a **MILLION** people have TV sets





There are a **HALF A MILLION** telephone lines

Bolivia has extremely **COLD & DRY** regions



Bolivia is a land of **MOUNTAINS**

Half of the work force is **FARMERS**

Bolivia is about **3 TIMES** the size of the state of Montana

Bolivia Facts*

Population:	8,300,463 (July, 2001)
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* Source: 1997 WHO statistics

Bolivia Water Project

The Village

Machaja Marca is a small village located in the Arque Municipality, outside of Cochabamba.

Fifty-two families live in the village. They are poor and don't have many opportunities to make money.

The people depend on farming for food and money. They grow potatoes and grains to sell and eat.

The Water Source

The women and children of the village use buckets to draw water from a natural spring. The pools are not protected – animals, wildlife and rodents also use this as their source of water.

The Problem

The local health clinic has found 60 percent of the children in the village suffer from diarrhea and scabies. A smaller percentage of the adults have the same illness.

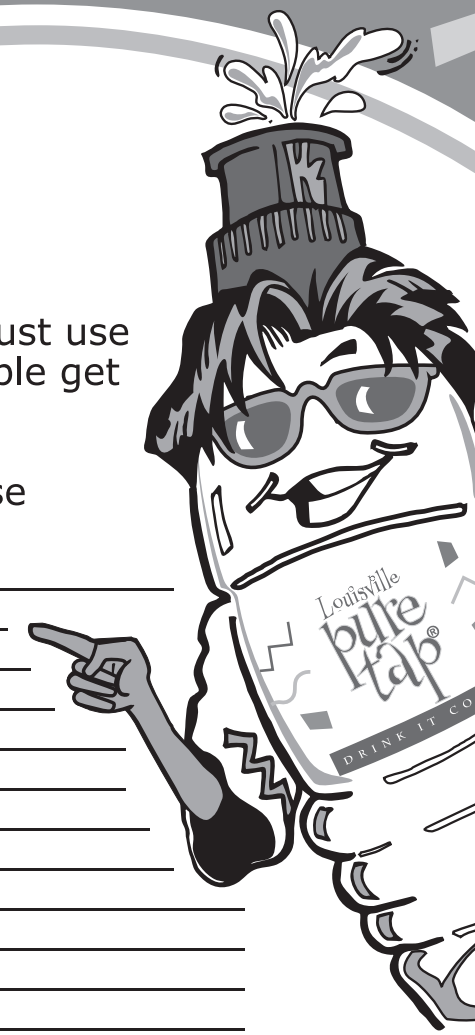
Lab tests show the spring water is safe to drink, but health officials are pretty certain it's the water that's making people sick.

The Question

If the spring water is safe, how is the water getting contaminated? Think about some possible ways the water could be contaminated.

What could the villagers do to reduce the number of people getting sick?

Open Response Question



Many villages in Bolivia have no bathrooms so people must use a nearby field. Often there are no water services so people get drinking water by collecting rain in jars.

A. List two problems that might develop because of these conditions.

B. Explain how you might solve each problem.

Water Project Answer and Open Response Scoring Guide.

The Question

If the spring water is safe, how is the water getting contaminated? Think about some possible ways the water could be contaminated.

The health officials in Bolivia assume that most of the contamination happens with how the people get the water, carry it and then store the water.

What could the villagers do to reduce the number of people getting sick?

To make the drinking water safe, the village needs a good storage system and a way to distribute the water to its people – rather than women and children carrying it.

Water For People is working with the villagers to construct a 2,000-liter water tank to store the water and a distribution network. The distribution system will carry the water to seven private tapstands and two public tapstands for the local school and orphanage.

Once the system is installed, Water For People will teach the village people about good hygiene. It's not enough to install a water system – the people must understand the importance of good sanitation and handwashing.

The total cost of this project is $4,834.

Open Response Question

A. List two problems that might develop because of these conditions.

B. Explain how you might solve each problem.

Scoring Guide

4– Student correctly lists two problems. (Disease from not washing hands after using the bathroom or from children playing in the field, contaminated water if the rain jar is dirty, lack of water to drink if there's no rain, children and families don't go to school or work because they get sick) Student shows an in-depth understanding of the solution (You not only install sanitation and water service, you let the people help so they have ownership of the system. You also teach them proper hygiene, like hand washing.)

3– Student correctly identifies one problem that might develop and offers a solution.

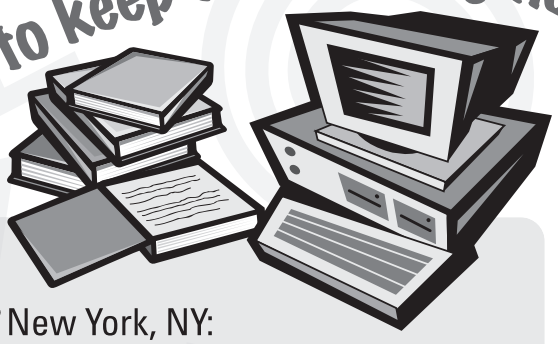
2– Student answers part A only.

1– Student offers partial answer to A.

0– No response.

Around The World

Check out these opportunities to keep the learning flowing!



Extra, Extra!!

Books:

Bare, C. (1991). *Who comes to the water hole?* New York, NY: Cobblehill Books. *Text and photographs look at the animals that visit a watering hole during the dry season in Africa.*

Cossi, O. (1993). *Water wars.* New York, NY: New Discovery Books. *Case studies examine water issues in California and the Middle East. Appropriate for grades 5-7.*

Swanson, P. (2001). *Water, the drop of life.* Minnetonka, MN: NorthWord Press. *This book accompanies a public television series by the same title.*

Web sites:

www.waterforpeople.org *Site about the organization that works to bring safe drinking water and sanitation to underdeveloped countries.*

http://ga.water.usgs.gov/edu/msac.html *Surveys for students about future water issues.*

http://uswaternews.com *Articles and updates on water supply issues in the United States and the world.*

www.travelvantage.com/bol_inf.html *Information on Bolivia.*

www.boliviaweb.com *Maps and pictures of historic sites in Bolivia.*

Louisville Water Company Opportunities:

LWC has a video that details the work of Water For People. Call the Public Information Department at 569-3600 to get a copy on loan.

www.tappersfunzone.com *Click on "Water For People" for a picture gallery and information on other countries where Water For People works.*

Schedule a phone conference with a Water For People representative. Hear first-hand about the work in Bolivia and other countries. Call the Public Information Department at 569-3600.